

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASPHALT INSTITUTE (AI)

AI MS- 10	(1986) Soils Manual for Design of Asphalt Pavement Structures
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 33	(1997) Concrete Aggregates
ASTM C 136	(1996; Rev. A) Sieve Analysis of Fine and Course Aggregates
ASTM C 412	(1994) Concrete Drain Tile
ASTM D 422	(1963; R 1990) Particle- Size Analysis of Soils
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Effort (12,400 ft- lbf/ ft (600 kN- m/ m))
ASTM D 1140	(1997) Amount of Material in Soils Finer Than the No. 200 (75- Micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand- Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft- lbf/ ft (2,700 kN- m/ m))
ASTM D 1586	(1984; R 1992) Penetration Test and Split- Barrel Sampling of Soils
ASTM D 1883	(1994) CBR (California Bearing Ratio) of Laboratory- Compacted Soils
ASTM D 2434	(1968; R 1994) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	(1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3212	(1996; Rev. A) Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
ASTM D 4253	(1993) Maximum Index Density of Soils Using a Vibratory Table
ASTM D 4254	(1991) Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	(1995; Rev. A) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEFINITIONS

1.2.1 Backfill

A specified material used in refilling a cut, trench, or other excavation, placed at a specified degree of compaction.

1.2.2 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.3 Cohesive Materials

Cohesive materials include materials classified by ASTM D 2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials

Cohesionless materials include materials classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.5 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D 1557 for general soil types abbreviated in this specification as "95 percent ASTM D 1557 maximum dry density."

1.2.6 Structural Fill and Controlled Backfill

A specified soil mix or gradation of materials constructed to attain maximum bearing strength and minimize consolidation or differential settlement under a load.

1.2.7 Embankment

A "fill" having a top that is higher than adjoining ground.

1.2.8 Excavation

The removal of soil, rock, or hard material to obtain a specified depth or elevation.

1.2.9 Fill

Specified material placed at a specified degree of compaction to obtain an indicated grade or elevation.

1.2.10 Hard Material

Weathered rock, dense consolidated deposits or conglomerate materials, (excluding manmade materials such as concrete) which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment with ripper teeth or the use of jack hammers for removal.

1.2.11 In Situ Soil

Existing in place soil.

1.2.12 Lift

A layer (or course) of soil placed on top of a previously prepared or placed soil.

1.2.13 Rock

Solid, homogeneous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe- mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement, exceeding 1 cubic yard in volume. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.14 Soil

The surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material.

1.2.15 Subgrade

The material in excavation (cuts) and fills (embankments) immediately below any subbase, base, pavement, or other improvement. Also, as a secondary definition, the level below which work above is referenced.

1.2.16 Topsoil

In natural or undisturbed soil formations, the fine- grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark- colored, fine, silty, or sandy material with a high content of well decomposed organic matter, often containing traces of the parent rock material.

1.2.17 Unsatisfactory Material

Existing, in situ soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in fill or embankment without excessive consolidation or loss of stability. Materials classified as PT, OH, or OL by ASTM D 2487 are unsatisfactory. Unsatisfactory materials also include man- made fills, refuse, frozen material, uncompacted backfills from previous construction, unsound rock or soil lenses, or other deleterious or objectionable material.

1.2.18 Working Platform

A layer of compacted crushed rock or natural stone that replaces the in situ soil to provide a stable, uniform bearing foundation for construction equipment to facilitate further site construction.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD- 12 Field Test Reports

- a. Fill and backfill test
- b. Select material test
- c. Porous fill test for capillary water barrier
- d. Density tests

1.4 REGULATORY REQUIREMENTS

Materials and workmanship specified herein with reference to applicable state and federal regulations. Where the term "Engineer" is used, it shall mean the Contracting Officer.

1.5 DELIVERY AND STORAGE

Deliver and store materials in a manner to prevent contamination or segregation.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations as indicated.
- b. No pipes or other man- made obstructions, except those indicated, will be encountered.
- c. The character of the material to be excavated or used for subgrade is as indicated in the geotechnical report.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Granular Fill

2.1.1.1 Capillary Water Barrier

Provide a capillary water barrier under concrete floor slabs, where shown on the Drawings, consisting of clean crushed stone, crushed gravel, or uncrushed gravel conforming to ASTM C 33 coarse aggregate grading size 57, 67, or 7.

2.1.2 Soil Materials

Provide materials free from debris, roots, wood, scrap materials, vegetable matter, refuse or frozen material. Maximum particle size permitted is 3 inches. Use excavated material from the site for the work indicated when material falls within the requirements specified herein.

2.1.2.1 Structural Fill and Controlled Backfill

Sieve Size (square openings)	Percent Passing by Weight
3 inch	100
3/4 inch	70 - 100
No. 4	40 - 100
No. 200	5 - 35

The plasticity index of the material, as determined in accordance with ASTM D4318, shall not exceed 12. The fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches in any dimension, or other deleterious materials.

2.1.2.2 General Backfill Beside Structures

Soft, spongy, highly plastic, or otherwise unstable material is prohibited. Material shall be classified as GP, GM, GC, SP, SM, ASTM D 2487 and meet the requirements of 2.1.2.1. If more material is required than is available from on- site excavation, then provide that material from approved sources.

2.1.2.3 General Site Fill, Backfill and Embankment Material

Provide a soil material from the site that can be readily compacted to the specified densities. Materials shall be classified as GP, GM, GC, SP, SM, SC, by ASTM D 2487.

2.1.2.4 Working Platform

Material and thicknesses of working platform for support of construction equipment shall be at the discretion of the construction contractor. The gradation and placement of such material shall not create large void spaces upon which overlying work is indicated to be placed.

2.1.2.5 Borrow

Provide materials meeting requirements for general site fill, structural fill, controlled backfill, general backfill, granular fill. Obtain borrow materials in excess of those furnished from excavations described herein from sources off Government property.

2.1.2.6 Sand

Provide clean non-plastic sand with 100% passing the No. 4 sieve and not more than 12% passing the No. 200 sieve.

2.1.2.7 Vapor Barrier

10 mil polyethylene sheet, with mastic or tape for sealing laps which is acceptable to manufacturer of vapor barrier material.

PART 3 - EXECUTION

3.1 PROTECTION

3.1.1 Protection and Restoration of Surfaces

Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance. Protect ditches from water-borne soil. Conduct work in accordance with requirements specified in Section 01575, "Temporary Environmental Controls."

3.1.2 Drainage and Dewatering

Plan for and provide the structures, equipment, and construction for the collection and disposal of surface and subsurface water encountered in the course of construction.

3.1.2.1 Drainage

Dispose of surface water which may accumulate in open excavations, unfinished fills, or other low areas. Remove water by trenching where approved, pumping, or other methods to prevent softening of exposed surfaces. Surface dewatering plan shall include rerouting of any storm water runoff or natural drainage if necessary and shall comply with requirements specified in Section 01575, "Temporary Environmental Controls." Collect and dispose of surface and subsurface water encountered in the course of construction.

3.1.3 Protection and Restoration of Surfaces

Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance. Protect existing ditches from water-borne soil by means of straw bale dikes and/or fences. Conduct work in accordance with requirements specified in Section 01575, "Temporary Environmental Controls."

3.1.3.1 Disposal of Excavated Material

Dispose of excavated material in such a manner that it will not obstruct the flow of runoff, endanger a partly finished structure, impair the efficiency or appearance of facilities, or be detrimental to the

completed work.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Perform as specified in Section 02231, "Clearing and Grubbing."

3.2.2 Stockpiling Topsoil

Strip approved topsoil to a depth of 6 inches from the site where excavation or grading is indicated and stockpile separately from other excavated material. Locate topsoil so that the material can be used readily for the finished grading. Protect and store in segregated piles until needed.

3.2.3 Unsatisfactory Material

Remove organic matter, sod, rubbish, and unsuitable soils under embankments which are less than 3 feet in thickness and under pavements or slabs on grade. Typical depth of removal of such unsuitable material shall be as required.

3.3 EXCAVATION

Excavate to contours and dimensions indicated. Keep excavations free from water while construction is in progress. Notify the Contracting Officer immediately in writing in the event that it becomes necessary to remove rock, hard material, or other material defined as unsatisfactory to a depth greater than indicated and an adjustment in contract price will be considered in accordance with the Contract clause entitled "Differing Site Conditions." Refill excavations cut below the depths indicated with structural fill and compact as specified herein. Excavate soil disturbed or weakened by construction operations or soils softened from exposure to weather. Refill with structural fill and compact as specified herein.

3.3.1 Excavations for Structures and Spread Footings

Excavate, where necessary, to provide a minimum of 24" of structural fill below the bottom of the building slab on grade, perimeter grade beams and interior tie beams, over excavation below pile caps is not required. If excavation is deeper than indicated, then fill with structural fill material prior to placement of footings.

3.4 FILLING AND BACKFILLING

3.4.1 Subgrade Preparation

Scarify the underlying subgrade surface to a depth of 8 inches before the fill is started. Step, bench, or break up sloped surfaces steeper than one vertical to 4 horizontal so that the fill material will bond with or be securely keyed to the existing material. Scarify existing surface to a minimum depth of 8 inches if subgrade density is less than the degree of compaction specified and recompact. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 8 inches and recompact as specified for the adjacent or overlying fill. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Subgrade fill shall be in accordance with paragraph 1.2.15.

3.4.2 Fill and Backfill Beside Structures

Place required backfill material adjacent to structures and compact in a manner that prevents wedging action or eccentric loading upon or against the structures. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Do not place material on surfaces that are muddy, frozen, or contain frost. Do not use equipment for backfilling operations or for the formation of embankments against structures that will overload the structure. Backfilling against concrete will be done only after approval has been obtained from the Contracting Officer.

3.4.3 Structural Fill and Controlled Backfill

Place structural fill and controlled backfill under spread footings, concrete slabs and pavements in loose lifts of 6 inches. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each lift as specified herein before placing the overlaying lift. Compaction shall be accomplished continuously over the entire area. Sufficient passes shall be made to ensure that specified density is obtained.

3.4.4 General Fill and General Backfill

Construct fill, backfill and embankment at the locations and to lines and grades indicated. Use only approved materials in constructing fill on the prepared subgrade. Place satisfactory material in horizontal lifts not exceeding 6 inches in loose depth. Do not place material on surfaces that are muddy, frozen, or contain frost. Compact with equipment well suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each lift as specified before placing the overlaying lift.

3.4.5 Final Backfill for Utilities

Construct backfill (final backfill) for utility lines and other utility appurtenances using the material and compaction requirements specified herein for the adjacent or overlying work. Bedding and initial backfill requirements are specified in Section 02302, "Excavation, Backfilling, and Compacting for Utilities." Backfilling against concrete will be done only after approval has been obtained from the Contracting Officer.

3.4.6 Fill for Capillary Water Barrier

Place granular fill over compacted subgrade. Compact granular fill in lifts of 4 inches with a minimum of two passes of a hand- operated plate type vibratory compactor per lift. Cover granular fill with two layers of vapor barrier followed by two inches of sand.

3.4.7 Weather Limitations

Fill and backfill shall not be constructed when weather conditions detrimentally affect the quality of the finished course. Place fill and backfill only if the atmospheric temperature is above freezing in the shade and is rising. Do not construct fill and backfill in the rain or on saturated subgrades. If weather conditions are windy, hot or arid, with high rate of evaporation, schedule the placement in cooler portions of the day and furnish equipment to add moisture to the fill or backfill during and after placement.

3.5 COMPACTION

Compact each layer or lift of material specified so that the in- place density tested is not less than the percentage of maximum density specified in Table I.

TABLE I

Percent ASTM D 1557

Maximum Density

	<u>Cohesive Material</u>	<u>Cohesionless Material</u>
<u>Fill, Embankment and Backfill</u>		
General Fill and General Backfill under steps and parking lots	90	95
General Fill and General Backfill under sidewalks and grassed areas	85	90
General Backfill and General Fill beside structures	90	95
Structural fill and Controlled backfill under footings, slabs, pavements and structures	95	100
Refill materials	N/A	100
Under Roadways, top 8 inches	95	100
<u>Subgrade (Top of fill, backfill or cut)</u>		
Under parking lots, top 8 inches	93	98
Under building slabs, steps, footings, top 8 inches	95	100
Under sidewalks, and grass areas, top 6 inches	85	90

3.6 FINISH OPERATIONS

3.6.1 Site Grading

Grade to finished grades indicated within 0.10 foot. Grade areas to drain water away from structures. Existing grades which are to remain but are disturbed by the Contractor's operations shall be restored.

3.6.2 Finishing Subgrades Under Structures and Pavements

Finish surface of top lift of fill or top of subgrade to the elevation and cross section indicated. Finished surface shall be smooth and of uniform texture. Lightly scarify or blade the finished surface to bring the finished surface to within 0.05 foot of the indicated grade and to eliminate imprints made by compaction and shaping equipment. Surface shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge.

3.6.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur and as required in the Section 01575, "Temporary Environmental Controls" and as specified in the paragraph entitled "Protection and Restoration of Surfaces." Repair or reestablish damaged grades, elevations, or slopes prior to acceptance of work.

3.7 FIELD QUALITY CONTROL

3.7.1 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.7.1.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.7.1.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.7.1.3 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.7.1.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut.

END OF SECTION